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ABSTRACT

This paper described a set of computer programs designed to assist the development of instructional programs utilizing a microcomputer-controlled videodisc player. The hardware and software systems and instructional programs were developed by the staff of the Interactive Videodisc for Special Education Technology Project (IVSET) at Utah State University. The criteria and description of the system design are presented, and the production elements that must occur prior to using the system are briefly described before use of the authoring system is explained. The second part of the paper describes the field test of the system conducted at the Utah State Training School in American Fork to (1) test the utility, effectiveness, and appropriateness of programs on time telling, identification of coins, and functional words for severely mentally handicapped students; (2) test the reliability of the hardware and computer programs; and (3) collect data for an analysis of the instructional sequencing. Results from a resource room field test conducted to obtain data concerning teacher use of the system are also presented. Specific and general conclusions drawn from both studies indicate that the system is an effective instructional agent for mentally retarded and learning disabled students. (LMM)

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MICROCOMPUTER/VIDEODISC AUTHORING SYSTEM For INSTRUCTIONAL PROGRAMMING

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MICROCOMPUTER/VIDEODISC AUTHORING SYSTEM

For INSTRUCTIONAL PROGRAMMING

This paper describes a set of computer programs designed to assist the development of instructional programs utilizing a microcomputer-controlled videodisc player. The project in which these programs were developed, and the field tests conducted to test the utility of the programs are briefly described to help establish the development context.

IVSET PROJECT

The hardware and software systems and instructional programs described in this paper were developed by the staff of the Interactive Videodisc for Special Education Technology Project (IVSET). The project is funded by a grant from the U.S. Office of Special Education, and is currently being conducted at Utah State University. The primary goal of the project is to develop and field test a system to provide Computer Assisted Instruction (CAI) for mentally handicapped students.

Because traditional CAI methods assume reading skills, they are not suitable for a majority of the population of mentally handicapped students. Consequently, it is necessary to use spoken instructions. Recently developed videodisc players coupled with a microcomputer provide the technology to deliver spoken instructions.

The hardware for the Microcomputer/Videodisc (MCVD) system consists of a Pioneer Model 7820 III Videodisc Player, an Apple II microcomputer with two 5¼" floppy disk drives, a SONY 12" color monitor and a Carroll Mgf. touch panel built into the monitor. The videodisc player was selected for its rapid, random access capabilities. A typical search and retrieval

of an instruction or feedback segment takes less than 1 second. The touch panel is a light interrupt system that allows the student to interact with the system by touching the monitor screen. The Apple II controls the system through computer programs and an interface devise (slot board). Both were designed and developed by IVSET Project staff. The videodisc system consists of the player and videodisc. The videodisc is the storage medium, but it has the approximate size and appearance of an LP phonograph record; is capable of storing 54,000 individual frames of video or 30 minutes of audio and motion video on each side; and has duel audio tracks. In this paper the total videodisc system is referred to as the videodisc.

The 7820 III player is the industrial model. It has a built in microprocessor and has rapid random access capabilities. Any position on the videodisc can be accessed and retrieved in less than 3 seconds. It has excellent still frame capabilities, and the audio and video reproduction is excellent.

The system interacts with the student by presenting an audio instruction and the associated visual image on the monitor. The student responds by touching the image of an object on the monitor screen. When the student touches the screen, two light beams transmitted from each axis of the touch panel are interrupted, and the point of interruptions is detected by the touch panel. The X and Y coordinates are then transmitted to the computer. The computer program in the microcomputer contains the correct coordinates for each segment of instruction. The coordinates transmitted by the touch panel are compared to these correct coordinates.

On a correct response, the microcomputer responds by finding and retrieving a segment on the videodisc which contains audio and visual feedback. Other possible response conditions are an incorrect response, and a non-response. Recorded segments are contained on the videodisc for these response

conditions as well as a variety of feedback, including animation and motion picture sequences.

Each segment of instruction has associated parameters that specify the number of times a student must respond correctly to advance to the next instruction segment. As the student interacts with the system, data are collected by the microcomputer and stored on a floppy disc by the Apple disk drive.

Six instructional programs have been developed for use with the MCVD system to date: (1) Matching Sizes, Shapes and Colors, (2) Time Telling, (3) Identification of Coins, (4) Functional Words, (5) Sight Reading, and (6) Directional Prepositions. The first four programs have been field tested with moderately mentally handicapped students. Programs 4 and 5 are presently being field tested in elementary resource rooms.

VIDEODISC AUTHORING SYSTEM

A major objective of the IVSET Project staff has been to develop a set of computer programs that could be used with any MCVD instructional program. This set of programs constitutes a general purpose authoring system for a microcomputer-controlled videodisc system. The system was designed to meet the following criteria:

1. An instructional programmer with little or no computer experience should be able to use the authoring system to write instructional programs.

2. The authoring sytem should provide the instructional developer with a high degree of flexibility in presenting instruction from either the microcomputer of the videodisc player.

3. The system should collect data for instructional analysis.

4. A teacher should be able to use the authoring system.

5. The authoring system should summarize student data and present it in a form useful for monitoring student progress.

The authoring system has been in development for the past three years and has been revised a number of times. The first version was programmed

in the PILOT language. PILOT was chosen because it is relatively simple to use and has good graphics capabilities. Three commands were added to the language to allow the microcomputer to communicate with the videodisc player and the touch panel. The PILOT language was later abandoned primarily for three reasons: (1) its execution speed was too slow; (2) even though it was relatively easy to use, it still required some programming skills; and (3) it was cumbersome to use when dealing with a large number of instructional segments and response conditions.

It became apparant that a system of computer programs should be developed to overcome these problems. The resulting computer programs were designed by the IVSET project staff, and programming was undertaken utilizing the BASIC programming language. BASIC was also soon abandoned when Pascal became available for the Apple. Pascal is capable of much faster execution speeds and has more utility when developing a system of large computer programs. The authoring system currently being used is programmed in Pascal with a few assembly language subroutines.

Instructional Scripting Process.

In order to explain the functions of the authoring system it is necessary to briefly describe the production events that must occur prior to using the system.

After an instructional area has been identified, production of an MCVD instructional program begins by designing instructional sequences in the form of a script. The script addresses both the audio and video aspects of the instructional sequence. Additionally the script must specify:

1. The source of the video (videodisc or computer generated graphics),

2. The source of the audio (the videodisc has two program selectable audio tracks),

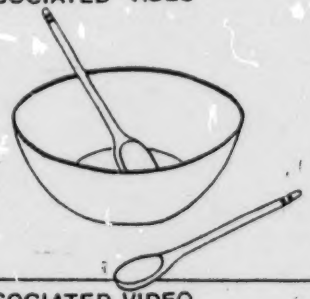
3. The type of segment (Instruction, Remediation, Test, or Feedback),

4. A segment number which is unique for each segment, and

5. The actual audio and video content of the segment.

A scripting form has been devised to provide for each of these specifications and content. See figures 1 and 2 for sample scripting forms.

Figure 1 illustrates a scripting form representing a segment of instruction from a program designed to teach directional prepositions. When this segment is presented to the student via the MCVD system, the bowl and spoons would appear on the monitor screen and the audio would be "Touch the spoon that's out of the bowl."

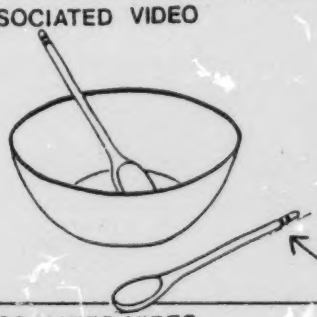
AUDIO	VIDEO	
AUDIO 1: 4787 Touch the spoon that's out of the bowl. 4863 Right. 4909 SF# _____ EF# _____	ASSOCIATED VIDEO 	☒ VIDEODISC [ ] TEXT [ ] GRAPHIC COMMENTS:
AUDIO 2: SF# _____ EF# _____	ASSOCIATED VIDEO (NOTE: Video associated with Audio 2 will be the same as video associated with Audio 1 unless graphics from the computer are used to modify the video.)	IVSET Interactive Videodisc for Special Education Technology

☒ INSTRUCTION [ ] REMEDIATION [ ] TEST [ ] FEEDBACK

QUESTION # 2110/2111

Figure 1

Figure 2 illustrates a remediation segment. The audio is specified under AUDIO 1 on the form. The video consists of the bowl and spoons plus the image of a teacher touching the spoon out of the bowl. The video teacher might be represented by an actor or a hand puppet.

AUDIO	VIDEO	
AUDIO 1: That was a nice try. Watch me. I am touching the spoon that is out of the bowl. Listen again. SF# 8733 EF# 8996	ASSOCIATED VIDEO 	[X] VIDEODISC [ ] TEXT [ ] GRAPHIC COMMENTS: Teacher is shown touching the spoon.
AUDIO 2: SF# _____ EF# _____	ASSOCIATED VIDEO (NOTE: Video associated with Audio 2 will be the same as video associated with Audio 1 unless graphics from the computer are used to modify the video.)	IVSET Interactive Videodisc for Special Education Technology

[ ] INSTRUCTION [X] REMEDIATION [ ] TEST [ ] FEEDBACK

QUESTION # _____

Figure 2

The entire script for the instructional program is written on the scripting forms. Hand written comments (see example in Figure 2) are also written on the forms to help in directing the actual production.

The script serves as a production plan. The set must be designed and built, actors identified and television studio time secured. Prior to studio

production, rehearsals are conducted and filmed on 3/4" videotape. The videotape is reviewed and necessary revisions are made. If possible, segments of the instruction are tested with an appropriate student.

Random access videotape equipment has recently been acquired for the project. This equipment will facilitate preliminary field testing because it will better simulate the final videodisc version.

The next step is to conduct the actual studio production. The entire script including instruction, remediation, feedback and testing segments are filmed on 1" videotape. This videotape is then sent to MCA Corporation to be converted (pressed) to videodisc. MCA provides the only service of this type in the country. SONY and 3M will be providing this service soon. Videodisc pressing typically takes about six weeks.

Using the Authoring System.

When the videodisc is ready, computer programs from the authoring system make their debut in the production process. The beginning and ending frame numbers for each segment on the videodisc must be identified. Additionally X and Y coordinates are used to locate images on the monitor screen. The coordinates are identified for each segment that requires a student response. For instance, coordinates for the segment represented in Figure 1 would identify both spoons in the locations they appear on the screen. This would elicit either (1) positive feedback if the student touched the correct spoon, (2) negative feedback specific to touching the spoon in the bowl and (3) general negative feedback if they touched anywhere else on the screen. One of the computer programs from the authoring system assists in the identification and recording of screen coordinates.

Another form, the Programming Form, is used at this point of production to record the frame numbers and coordinates and to set up the logic associated

with a particular instructional segment. Figure 3 illustrates a Programming Form.

The form in Figure 3 has six of twelve possible subblocks completed. The following explains the function of each subblock:

1. The first subblock, designated by an I, identifies the instruction segment.

2. The second subblock, designated by a C, specifies the consequence of a correct response. In this case the word "right" is retrieved and presented to the student.

3. The next three subblocks, designated by 1, 2, and 3, refer to consequences following the first, second and third incorrect response. Subblock 1 presents the words "not right." The second subblock presents the statements "That was a nice try. Watch me. I am touching the spoon that is out of the bowl. Listen again." Subblock 3 activates a buzzer which signals for help from the teacher. It's assumed that help is required after the third incorrect response since the student was given the correct answer after the second incorrect response. After each incorrect response, the initial instruction segment is replayed as indicated in the GOTO entry.

4. The sixth subblock, designated by an S1, specifies the consequence associated with touching the location on the screen identified by the specific coordinates. In this case, if the student touched the spoon in the bowl, the system responds with "No, that is the spoon in the bowl. Touch the spoon out of the bowl." The instruction segment is then repeated.

The Programming Form provides for a number of logic controlling indicators. They are briefly explained in the next section.

Program Control.

In addition to those functions previously explained, the system accepts additional logic controlling parameters. These are also specified on the Programming Form. Parameters serve several functions for the instructional programmer. For example, parameter values identify the beginning of a test, indicate the number of responses required in a test and indicate the number of incorrect responses a student is allowed before failing the test. Parameters allow the instructional programmer to vary the number of incorrect responses allowed for a particular instruction segment. A certain

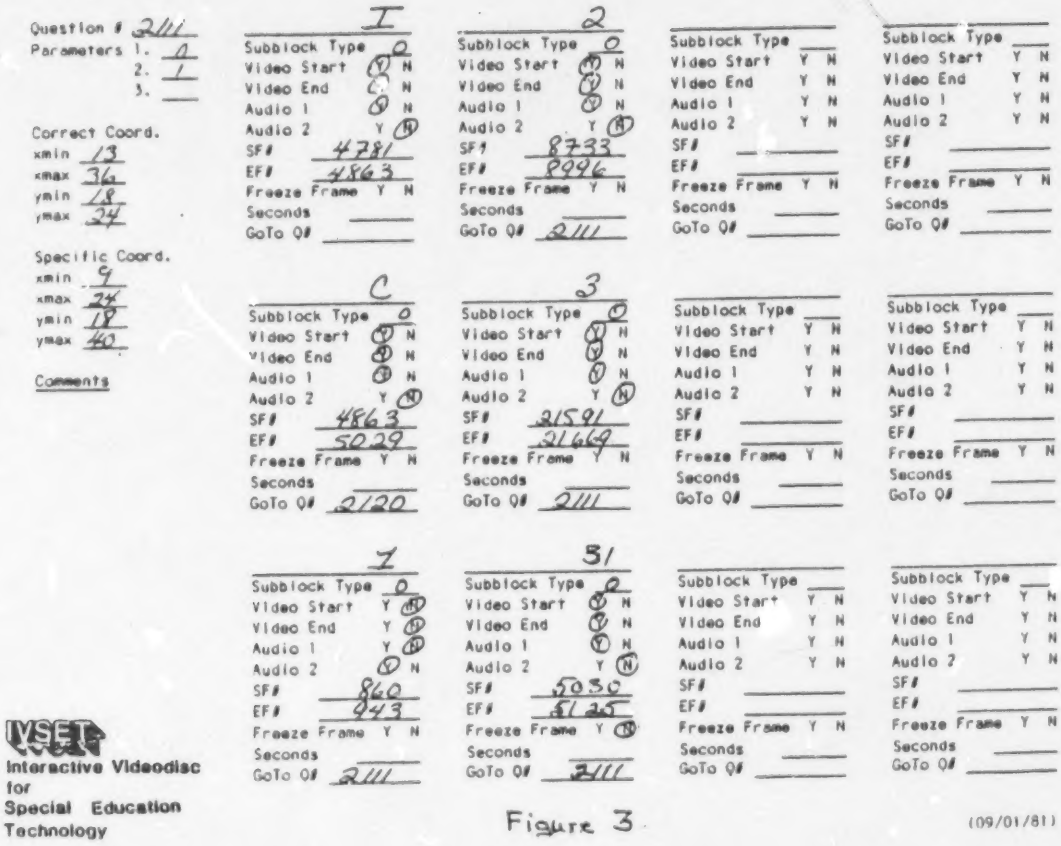


Figure 3

setting of the parameters instruct the computer to wait or not to wait for a student response, and the parameters are used to instruct the computer to retrieve computer produced text or graphics.

GOTO Instruction. The GOTO instruction indicates the next segment to be executed after the subblock instructions are executed. Each subblock contains a GOTO instruction.

Subblock Identifiers. Subblock identifiers define the function of each subblock. The various subblocks include an instruction subblock, correct, incorrect and specific subblocks. The following is a list of possible subblocks and their identifiers.

I ---- Instruction
C ---- Correct
1 ---- 1st Incorrect
2 ---- 2nd Incorrect
3 ---- 3rd Incorrect
4 ---- 4th Incorrect
S1 ---- 1st Specific Correct or Incorrect
S2 ---- 2nd Specific Correct or Incorrect
S3 ---- 3rd Specific Correct or Incorrect

Subblock Type. Defining subblock types allows the instructional programmer to vary the function of each subblock. The subblock types are currently defined from 0-5. These values elicit the following functions:

Subblock Type = 0. Play videodisc frames and execute the GOTO instruction.

Subblock Type = 1. Present defined text and execute the GOTO instruction.

Subblock Type = 2. Ignore the videodisc frames and execute the GOTO instruction.

Subblock Type = 3. Not used.

Subblock Type = 4. Play the videodisc frames, initiate the assistance signal, and execute the GOTO instruction.

Subblock Type = 5. Initiate the assistance signal, inform the user to turn the videodisc over, and execute the GOTO instruction.

Video Flags. Video start and video end flags require a yes or no selection. When the video from the videodisc is to play, both video start and video end should be Y(yes). When the video from the videodisc should be blanked out, the video start and video end flags should both be N(no).

Audio Flags. The Audio 1 and Audio 2 flags allow the instructional programmer to select either audio track or both audio tracks programmatically. To play both Audio 1 and Audio 2, both flags should be Y(yes). To play only Audio 1 set the Audio 1 flag to Y and Audio 2 to N and vice versa.

Starting and Ending Frame Numbers. Specifies the beginning and end of each videodisc segment.

Freeze Frames. The freeze frame feature allows the instructional programmer to present a videodisc segment and wait before executing the GOTO instruction.

The length of the wait is determined by the programmer.

Creating Instructional Data Files.

After programming forms have been completed, the information on the forms must be stored on a floppy diskette. This procedure requires the use of the Data Entry program. Using this program, question parameter data can be entered by anyone with a working knowledge of the microcomputer keyboard and some experience with handling floppy diskettes.

Debugging Data Files.

As with all computer programming endeavors, debugging is a major activity. A program is available from the authoring system to assist in the debugging process. The program scans the instruction data files and checks for the following:

* Missing GOTO values
* Too many N flags
* Minimum coordinate values exceeding maximum coordinate values
* Impossible GOTO values
* Zero value frame numbers
* Starting frame numbers exceeding ending frame numbers.

This level of debugging is basically concerned with syntax and missing or illegal parameters. The next level involves debugging the logic.

This second level is very ardous since it involves checking every situation the student might encounter when interacting with the system and program in question. The instructional flow logic is checked as well as the appropriateness of feedback. The accuracy of monitor screen coordinates and frame numbers is verified. Debugging is critical to the success of the program since it is anticipated that the student will work independently with the system. Consequently, the instructional developer cannot depend on teacher interpretation of ambiguities or errors in the instruction.

Collection of Student Data.

A major project objective is to investigate the feasibility of using the MCVD system with mentally handicapped students. It represents one of the first attempts to provide operational CAI to non-readers. The system is unique in this sense, and there is a lack of research knowledge directly applicable to developing CAI for this population. Therefore, the developers have found it necessary to collect research data about instructional sequencing in addition to data concerning student progress.

Data collection is relatively simple given the large storage capacity of the floppy disk system. Data are collected on the type of response (correct, incorrect, or non-response) and the time to respond. This amounts to a large amount of data since past experience suggests that students using the MCVD system respond an average of 8 times per minute. Also maintained on the student data files are the beginning and ending segment numbers for each session and the total elapsed time of the session.

Student Data Summarization.

The segment number, which is unique to each segment, was designed to identify a particular segment, the type of segment (instruction of test question) and the instructional objective of which the segment is a member. Summarization is possible by objective and type of segment. Four different types of summarizations and formats are available to the student, teacher and instructional developer:

1. At the end of a session the student is presented with a graph indicating progress by objectives (See Figure 4). The graph is presented on the monitor screen and is also available in hard copy.

2. A hard copy graph illustrating the number of sessions per objective (See Figure 5).

3. A hard copy listing of every response during a session including the type of response and the time required to respond (see Figure 6).

4. A hard copy listing which summarizes progress for each student in a group.

The data from each student file is transferred periodically to a larger mainframe computer for permanent storage on magnetic tape. Student demographic data are also stored on these tape files. Analysis of the data can then be accomplished with statistical analysis systems such as SPSS or SAS.

FIELD TEST

Training School Field Test

Purpose. A field test of the MCVD system and three instructional programs was conducted at the Utah State Training School in American Fork, Utah between October 1, 1981 and February 14, 1981. Three instructional programs were used: (1) Time Telling, (2) Identification of Coins, and (3) Functional Words. The four objectives of this field test were to (1) test the reliability of the hardware and computer programs, (2) collect data for the analysis of the instructional sequencing, (3) investigate the instructional effectiveness of the three instructional programs and (4) determine the appropriateness of using the system with severely mentally handicapped students.

The hardware, computer programs and instructional programs were considered to be in prototypical form. Even though comparison groups were used, it was not considered a summative evaluation. The field test evaluation was formative in that the intent was to collect data to assist in the continued development activities of the project.

Population. A major question regarding the MCVD system and instructional programs is their applicability to various handicapped populations. It was determined that the most efficient procedure would be to begin with the

more severely handicapped and then move to levels of less severity. There is a fair amount of evidence to suggest that students with low ability require smaller increments between instruction steps.

The system is designed to allow the student to progress through the instruction at his/her own rate. Therefore, if a less severly handicapped student does not require the extensive remediation built into the instructional sequences, the sequences will be skipped.

The population at the Training School was ideal for this field test for several reasons. There is a large accessible population of approximately 180 residents. Second, the Training School has students with a diverse range of handicapping conditions including moderately, severely and multiply handicapped persons. Third, the Training School staff were very interested in the potential for individualized instructional systems especially in the area of living skills.

Sampling Procedure. The system and the three instructional programs were demonstrated to the teachers and psychologists at the Training School. Based on this demonstration, they determined which students would be appropriate for each of the three programs. This determination was based on the staff's perception of each student's ability level and their past experience with the three areas of instruction. From this initial determination and with consultation from the staff, the minimum Mental Age (MA) criterion of 6 was established for the Time Telling program, minimum MA of 5 for Functional Words program, and MA of 4 for the Coins program. This provided a measure for initial screening. Final screening was accomplished through pretesting.

The selected subjects were randomly assigned to two groups within the Time Telling and Coins programs. One group was to recieve instruction from the MCVD system, and the comparison group was to receive one-to-one instruction from an aide using a paper and pencil version of the Time Telling and Coins programs. A comparison group was not established for the Functional

Words program because a paper and pencil version was not available.

An attempt was made to minimize teacher intervention with the MCVD groups in order to determine the effectiveness of the MCVD program independent of this factor. The IVSET staff members conducting the field test were instructed to intervene when there was an equipment problem, a behavior problem or when it was very evident that a student would not be able to pass a particular objective. A criterion of ten sessions on the same objective was established as the point to provide intervention.

Data Analysis

This section is organized according to the field test objectives stated in the Field Test Purpose Section.

1. Hardware Reliability. The reliability of the software was good. No major bugs were discovered in the computer programs, although the reliability of the hardware was a problem.

Two systems were in operation at the field test site, and during the first two week period there were an average of 6 equipment breakdowns per day. Almost all of these breakdowns were caused by malfunctions in those parts of the system that were prototypical: (a) the interface board, (b) the touch panel, and (c) an experimental board that allowed video from both the videodisc and the computer to be displayed on the screen at the same time. This board mainly caused an overheating problem which was relieved by the addition of a small fan.

It should be noted that the Apple, videodisc player, and monitor were not a source of hardware problems. This finding is important because improvement of these devices is not easily accomplished.

By the end of the field test, the reliability had improved considerably. It was still a problem, but breakdowns had been reduced to 2 per day.

Problems with hardware reliability have been steadily solved. In a subsequent field test in a resource room breakdowns averaged 1 every other day. In a field test currently being conducted, two MCVD system have been operating in two resource rooms for a total of 20 days without a breakdown.

2. Instructional Improvement. The progress of each student was continually monitored. In addition to data collection with the MCVD systems, observation forms were used to record software and hardware problems, student behavior problems, frequency, and type of teacher intervention and general comments.

Data collected by the system are summarized and analyzed daily. When a problem was detected, the source of the problem was pursued through the use of both the machine-collected data and the observational data. In most cases the problem could be isolated to a particular segment of instruction.

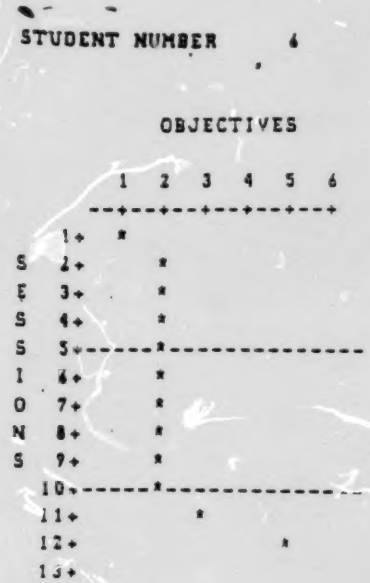


Figure 4. Each asterisk indicates an objective the student is working on during a particular session.

In one case the students were having a very difficult time getting through objective #2 of the Time Telling Program (See Figure 4). Examination of the data revealed that all the students were having difficulty on the same segments and that these segments occured every other time in a particular part of the sequence. It was discovered that the instruction was requiring the student to remember the choice made on the previous response. This was not meant to be part of the instruction.

This problem was sufficiently severe to warrant modifying the system. The problem was solved by installing an interlacing board. This board allowed a video prompt to be projected on the screen to remind the student of their previous choice. Thereafter the response pattern changed, and the students were able to progress through the problem objective.

In another instance examination of the response data identified a major sequencing problem in the Coins program. Refer to Figure 5 and note where the question number changes from 459 to 160. Also note that the next nine responses for this student have relatively long latency time (the time between presentation of the instruction and a response.)

Approximately 25 seconds was considered a non-response. The student is reminded by the system to respond, and the same instruction is repeated. When a question number is lower than the previous number (459 and 160), it indicates that the student has been cycled back to previously encountered instruction.

The pattern for the student represented in Figure 5 was also found for other students. The pattern indicates that recycling through the same instruction is not a good method of remediation for this particular instruction. Rectifing the problem would have required a major change in the program, and therefore was not attempted during the course of the field test, although, these data were valuable in subsequent program development.

ITEM ANALYSIS DATA

Student Number	Session	Question Number	Answer	Latency	TEACHER SIGNALS
1	7	390	0	133	
1	7	400	1	61	
1	7	410	0	9	
1	7	420	0	29	
1	7	430	1	139	
1	7	430	0	15	
1	7	440	0	140	
1	7	450	0	41	
1	7	452	0	236	
1	7	453	0	93	
1	7	454	0	29	
1	7	455	0	6	
1	7	456	0	9	
1	7	457	0	13	
1	7	458	2	249	
1	7	459	1	14	
1	7	160	2	250	
1	7	162	1	65	
1	7	140	2	250	
1	7	140	2	251	
1	7	140	0	155	
1	7	150	2	251	
1	7	152	1	133	
1	7	152	2	249	
1	7	140	0	229	
1	8	140	0	0	
1	8	150	0	124	
1	8	160	0	209	
1	8	170	0	113	
1	8	180	0	11	
1	8	190	0	117	
1	8	200	0	14	

Figure 5. Each entry indicates a student response. Answer key: 0=correct, 1=incorrect, and 2=non-response. Latency is time to respond after instruction in seconds.

3. Instructional Effectiveness. The paper and pencil comparison groups were established to provide comparative effectiveness data that could be used to identify problems in the MCVD instruction. This design was not used to determine which method of teaching was best. Because of equipment problems in the MCVD groups the paper and pencil groups had more actual instruction time over the duration of the field test.

It was evident, however, that the paper and pencil groups progressed at a higher rate than the MCVD groups even when down time was considered. All groups progressed during the 11 week period, and all groups except the MCVD Time Telling group made statistically significant gains between the pre-test and post test. The pre and post tests were paper and pencil tests and were the same for all groups. Table 1 lists the means, standard deviations, and t values between the pre and post tests for each group.

&&

PROGRAM	GROUP		PRE TEST	POST TEST	t-VAL Prob
IDENT. of COINS	MCVD	Means	6.25	8.75	t=3.Ø
		SD	2.53	3.17	p<.Ø1
	P&P	Means	4.42	1Ø.17	t=6.1
		SD	2.61	2.89	p<.Ø5
TIME TELLING	MCVD	Means	8.66	1Ø.33	t=1.Ø
		SD	2.87	4.47	p>.Ø5
	P&P	Means	11.[illegible]	15.18	t=2.9
		SD	3.Ø2	4.48	p<.Ø5
FUNCTL WORDS	MCVD	Means	17.75	22.ØØ	t=2.7
		SD	3.54	3.25	p<.Ø5

Table 1. Means, standard deviations and t values between pretest and post test score for each group.

Resource Room Field Test

A subsequent field test was conducted in a resource room in Logan, Utah between April 1, and May 15, 1981. The major purpose of this field test was to obtain data concerning teacher use of the system. The field test at the Training School was conducted by IVSET Project staff and did not involve teachers that were independent of the project. In the resource room

PROGRAM	GROUP		IQ	MA	CA
IDENT. of COINS	MCVD	Means	27.67	52.00	25.17
		SD	5.88	5.91	7.36
	P&P	Means	29.75	29.75	23.17
		SD	6.14	5.96	9.33
TIME TELLING	MCVD	Means	42.91	76.54	24.18
		SD	11.69	16.34	5.42
	P&P	Means	42.47	78.12	25.71
		SD	7.98	11.11	6.14
FUNCTL WORDS	MCVD	Means	33.00	64.67	29.91
		SD	9.00	15.61	10.39

Table 2. Means and standard deviations for the students in each group for IQ, Mental Age (MA), and Chronological Age (CA). MA and CA in months.

the teacher was responsible for conducting the field test, and an IVSET Project staff member collected extensive observational data for use in the refinement of a classroom managment manual.

There were four first and second grade students involved in this study. Three were classified as learning disabled and one as mildly retarded. The average WISC-R score for the four students was 82. All four students completed the Time Telling program within the six week period. Pretest results indicated that none of the four students could tell time before starting the program. All four could tell time at the end of the program, as measured by a post test that was independent of the MCVD system.

CONCLUSION

The following conclusions are based on results of the two field tests. They are organized according to objectives for the authoring system (see page 3).

1. The instructional programmers who developed the Coins, Time Telling and Functional Words programs had no computer programming experience. They were able to use the authoring system and to develop the logic for the instructional sequences to build and debug the instructional data files.

2. During the instructional development process, changes were made in the authoring system to provide capabilities desired by the instructional programmers. The resulting system was sufficiently flexible to accomodate the needs of the instructional programmers for the three programs. Additional changes have been made to accomodate two new instructional programs presently being field tested (Directional Prespositions and Beginning Reading). The project staff felt the authoring system has reached the degree of flexibility needed for future MCVD instructional development.

3. The data collected during the Training School field test provided the information necessary to make required changes both during the field test and after the field test. Based on the response data collected, the two new programs were developed with different remediation cycles than were included in the first three programs. One of the new programs was designed specifically to investigate different levels and typs of remediation.

4. The resource room teacher was able to use the system after two hours of training. A prototype classroom management manual was made available to the teacher which the teacher found useful in the operation of the system.

5. The resource room teacher used the graphical data supplied by the system to track student progress. These graphs were also used as reinforcement for students. The graphical information is now directly available

to the student at the end of a session. The feedback is in the form of a thermometer graph.

General Conclusions

Based on the field test data analysis, it was determined that the MCVD Time Telling program was too high level for the population at the Training School. This conclusion was reached after the students in the resource room completed the program in six weeks. The Training School group finished 25 percent of the 12 objectives in 11 weeks. It is possible, but not cost effective, to reprogram the Time Telling programs. The concepts are relatively difficult, but not impossible as evidenced by the success of the paper and pencil group.

The question most important in the development of future MCVD instructional programs is: How can the developer best design remedial interventions to accomodate learner's different ability levels? The MCVD Beginning Reading program presently being field tested was designed specifically for investigating different intensities and types of remedial feedback. Information gained from field testing this program should be very valuable for future MCVD instructional developments.